



TELINK SEMICONDUCTOR

Specification For TLSR8258-based BLE Audio Remote Control Demo

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Brief:

This document is a product specification for Telink BLE (Bluetooth Low Energy) Audio Remote Control demo based on TLSR8258.

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Revision History

Version	Major Changes	Date	Author
1.0.0	Initial version	2018/9	WSH, HZF, Cynthia
1.1.0	Updated section 1.2 Electrical specification. Added section 13 Reference Design and 14 Appendix 1: FCC Test Result.	2019/1	TJB, LX, Cynthia

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1 Introduction

In this document, the BLE remote control (RC) specification is described in details based on one sample use case. This model of remote control has button function and voice command function, and it's built on Telink's TLSR8258F512 platform.

1.1 Supported features

The RC demo supports the following features:

- works with dual batteries
- 25 valid buttons and 1 indicating LED
- Telink proprietary voice service
- Voice compressed with ADPCM, supported sample rate 16khz/16bit
- OTA firmware upgrade
- PC tool for button display and demonstration
- Low power consumption

1.2 Electrical specification

Current consumption for the RC demo is shown as below:

- Voice commands: ~5mA
- Button press: 0.8~1.2mA
- Short suspend*: ~10uA
- Long sleep: <1uA

RF Characteristics:

- Sensitivity: -96dBm @ BLE 1Mbps (Packet format: Prbs9)
- Tx output power: 10dBm (maximum setting)

Working distance:

- Button press: >30m
- Voice commands: >15m

***Note:** These numbers may vary depending on the host side BLE solution provider and the operating system configurability.

1.3 Button layout

The RC demo supports 25 valid buttons as shown in Figure 1, including:

- ✧ Up
- ✧ Down
- ✧ Left
- ✧ Right
- ✧ OK
- ✧ Home
- ✧ Back
- ✧ Vol+
- ✧ Vol-
- ✧ Audio
- ✧ 0-9 Digits
- ✧ Menu
- ✧ Mute

TV control area:

- ✧ Power
- ✧ Vol-, Vol+

Other buttons on the RC demo are reserved for future use. For example, the “**TV/AV**” button in TV control area can be extended for IR/BLE mode switch (see **Section 7**), and the “**Learn**” button can be extended for IR learning function (see **Section 8**).



Figure 1 Telink BLE RC demo

Telink sample BLE dongle is shown in Figure 2.

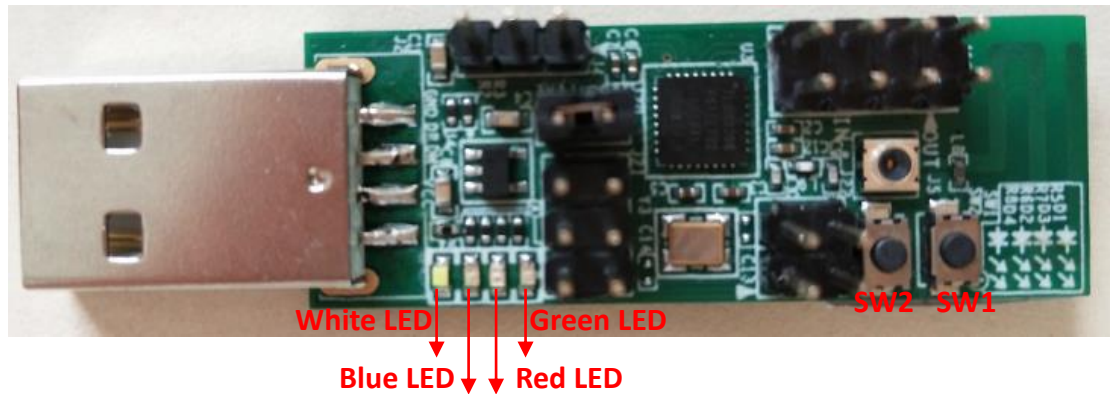


Figure 2 Telink BLE Dongle demo

2 Factory Test Mode

Factory test mode is customizable depending on user's requirement, and it's not supported by all RC demos.

Following shows an implementation example:

Press the specific combination buttons (e.g. press 1+2+3 digital buttons at the same time), power on the RC with the buttons held, the indicating LED of the RC will blink (e.g. blink 2 times with 1Hz frequency) to indicate the RC enters factory test mode.

In factory test mode, the RC won't send pairing/adv packet unless specific button (e.g. "Power") is clicked. This mode is used to test key values in a controlled way (e.g. user can determine when to send pairing/adv packet).

The RC will exit factory test mode and enter normal state by clicking specific button (e.g. "Mute").

3 Factory Reset Mode

Factory reset mode is customizable depending on user's requirement, and it's not supported by all RC demos.

After the RC is powered on, if it's not connected to the demo dongle, the factory reset mode (if supported) can be triggered by pressing the specific combination buttons (e.g. Home + Left) for several seconds (e.g. 3s). The indicating LED of the RC will blink several times (e.g. 3 times) to indicate the RC is reset to its factory default state.

4 Pairing and Un-pairing

NOTE: The RC needs to be paired with the demo dongle before it can be used. Telink samples provided to customers are already paired, so the pairing steps in this section can be skipped.

Before pairing operation, both the RC and Dongle should be burned with the right firmware, respectively. Telink-supplied RC and Dongle samples are preloaded with FW already. If user needs to update the FW, please follow the operations as described in the document ***"AN_FBD-EVK-UG_Firmware burning and debugging User Guide"*** or implement OTA upgrade (see section 12).

The RC demo supports pairing and un-pairing initiated by the demo dongle side.

4.1 Pairing between RC and dongle

The pairing operation is as shown below:

- 1) Power on the BLE RC. Insert the BLE Dongle into PC.
- 2) Click the "SW1" button of the BLE Dongle to start pairing process.
- 3) The red LED light on the BLE Dongle will be turned on and keep the state always to indicate successful pairing.
- 4) After power cycle the paired RC/Dongle, it's not needed to click the "SW1" button again and the RC will be paired with the Dongle automatically.

- 5) After the BLE RC is successfully paired with the Dongle, if the RC is powered down or the communication is disconnected, the white indicating LED light on the Dongle will also be turned on. Power on the RC again or reestablish the communication, the white light will be turned off.

4.2 Un-pairing

Once paired with the Dongle, the RC can be manually unpaired using the following sequence:

- 1) Click the “SW2” button of the BLE Dongle to start un-pairing process.
- 2) The red LED light on the BLE Dongle will be turned off to indicate successful un-pairing.

5 Button Function

After the BLE RC is successfully paired with the Dongle, the RC can send certain key value by pressing corresponding button. The function of each button is shown as in **Section 1.3**.

To test the simple button input, no special PC tool is needed. User can open up Notepad on the PC with dongle plugged in, key presses such as 1, 2, 3, ..., will be directly taken as input to the text file.

User can also use PC tool (KeySimulator) to simulate button press, release and repeat on the RC.

6 Audio input control

To use the audio input function of the RC, the user needs to press the “Audio” button and hold for 1s, and then recording is started. During recording process, user should release the “Audio” button, and the indicating LED light on the RC will be turned on.

Press the “Audio” button again to exit the recording process. The LED on the RC will be turned off.

*Notes:

- Distance between mouth and RC Audio button should be kept within 40cm or less;
- If any other key is pressed during recording process, the corresponding button function is customizable as normal/ignored, and the recording process continues.

Common audio input software (e.g. Audacity or Sound Recorder) can be used on PC side to record audio input.

7 IR/BLE Mode Switch

IR/BLE mode switch function is customizable for the RC demo that supports both BLE mode and IR mode.

The RC which has IR hardware built in and IR functions loaded will enter BLE mode by default after power on. User can click the “TV/AV” button to switch mode between IR and BLE. When the RC enters deep sleep, the current mode is saved; after wakeup by button press, the RC will be restored to the previous mode.

In IR mode, all buttons can send out corresponding IR key code by pressing the button.

8 IR Learning

IR learning function is customizable depending on user's requirement, and it's not supported by all RC demos.

Following shows an implementation example.

- Press specific button (configurable, e.g. "Learn" button) on Telink RC with IR learning support, and hold the button for 2s (configurable) until the indicating LED on the RC is turned on.
- Press specific IR learning button (e.g. "Power" button) on the RC to trigger IR learning mode. The indicating LED on the RC starts blinking.
- When the indicating LED on the learning RC is blinking, align its IR emitter with the "Power" button on the target RC which is to be learned, and keep the distance as 2~3cm. Press the "Power" button on the target RC to send out corresponding key code.
- After the learning RC obtains the key code of the "Power" button on the target RC, its indicating LED will slowly blink 3 times to indicate successful IR learning.
- During IR learning process, the RC can exit the mode by pressing any button other than the IR learning button (i.e. "Power" button).

9 Low Battery Detect

Telink RC sample supports low battery detect function.

The implementation method of low battery detect function is customizable depending on user's requirement. One typical implementation is shown as below:

When battery voltage drops below 2.0V, the indicating LED of the RC will fast blink three times, and then the RC will be shut down automatically. In this case, user should replace the battery.

*Note: Frequency and number of times of the indicating LED blinking are customizable.

10 Repeatable Buttons

Each button on the RC is customizable as repeatable button depending on user's requirement.

For example, generally the following group of buttons can be customized as repeatable buttons:

- Left
- Right
- Up
- Down
- VOL+
- VOL-

Under BLE mode, when the repeatable buttons are pressed and held, the key values will be sent at 250ms (configurable) intervals.

Except for the buttons customized as repeatable buttons, all the other buttons are treated as non-repeatable keys.

11 Couch Time

Couch time is customizable depending on user's requirement, and it's not supported by all RC demos.

This feature is used to save power for RC when some button is pressed by mistake and held for a long time.

- The RC will only transmit one packet if a non-repeatable button is pressed and held.
- However, if a repeatable button is pressed and held, it will keep transmitting packets for up to 60 seconds after which the RC will stop transmitting until the pressed button is released.

12 OTA firmware upgrade

This feature is used to upgrade the RC firmware using the Telink PC tool (Key Simulator), a burning EVK and the dongle demo.

The operation is described as below:

1. Download new Firmware (FW) into the dongle.
 - 1) Connect hardware: Connect the burning EVK with PC via an USB cable, and connect the dongle with the EVK via USB interface.



Figure 3 Connect EVK, Dongle and PC

- 2) Start the “KeySimTool” on PC side. Click the “Download” button on the interface, and select the new FW (e.g. 8258_ble_remote.bin) in the “Open” window.

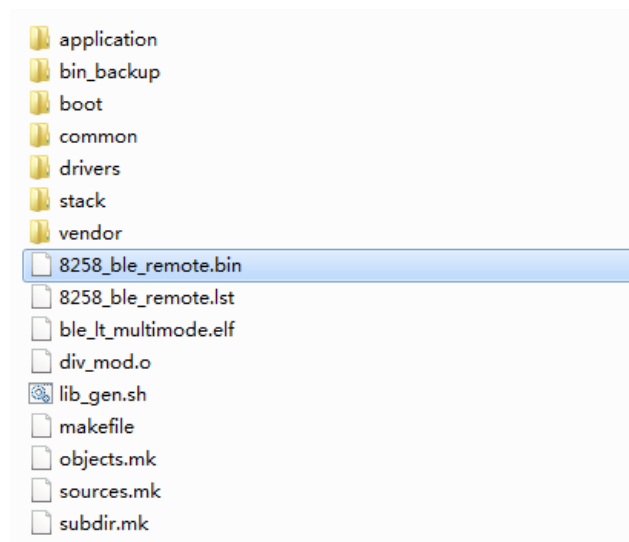
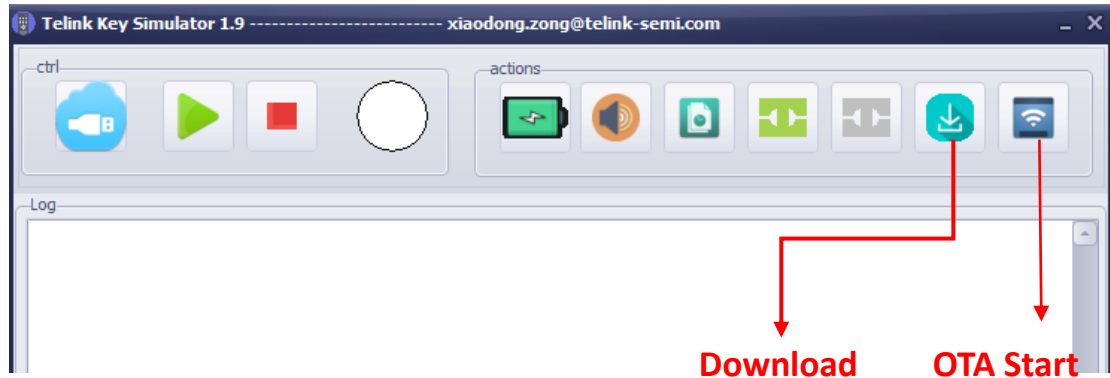


Figure 4 Open new firmware

- 3) After the FW is successfully downloaded into the Dongle, the log window of the interface is shown as below:

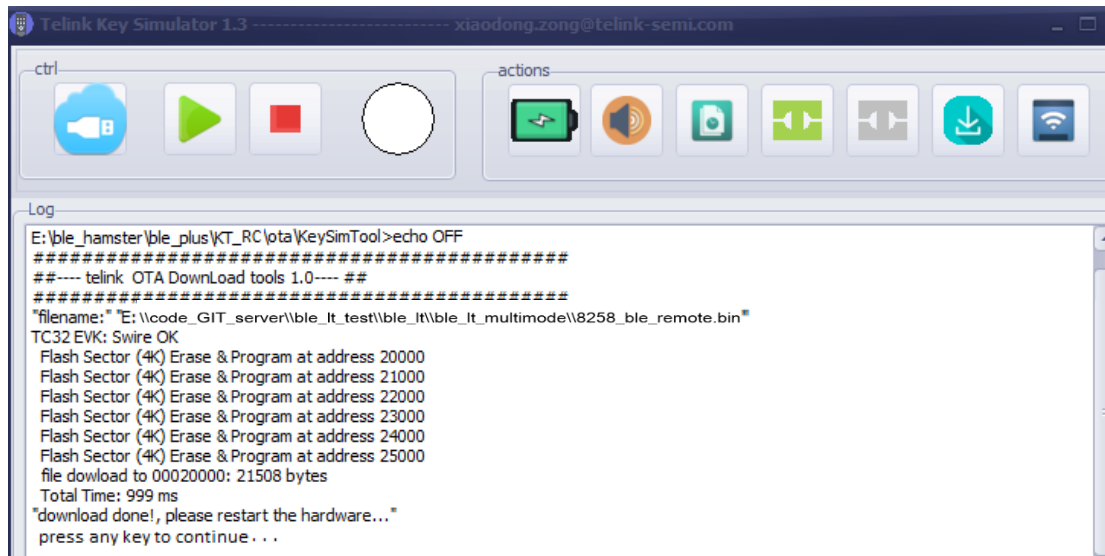


Figure 5 Successful downloading indication

2. Insert the dongle into PC USB. Make sure that the RC is connected with the dongle in BLE state (i.e. the red light of the dongle is on, and the white light is off), at the same time the button and audio function should be OK.

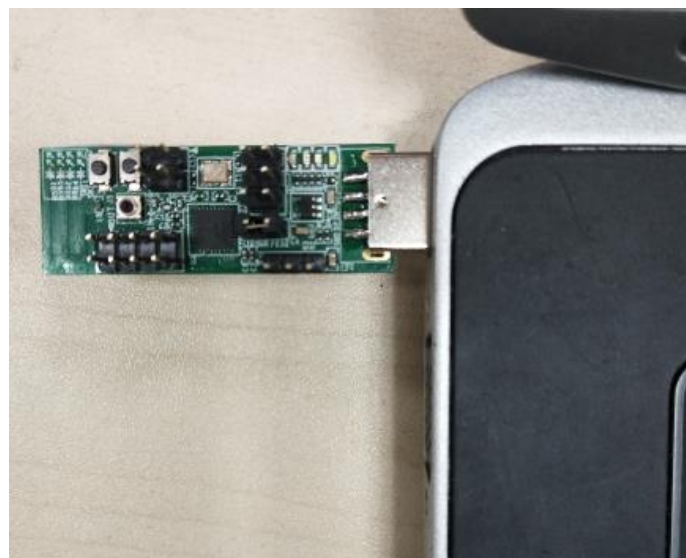


Figure 6 Insert Dongle into PC

3. Click the “OTA Start” button on the “KeySimTool” interface (as shown in Figure 4), the blue light of the dongle (as shown in Figure 2) will be turned on to indicate the dongle is in OTA mode.
4. When the blue light of the dongle is turned off, the OTA process ends. The OTA result can be checked in the log window of the “KeySimTool” interface.

Figure 7 indicates successful OTA FW upgrade.



Figure 7 OTA success

Figure 8 indicates the timeout duration for OTA expires.

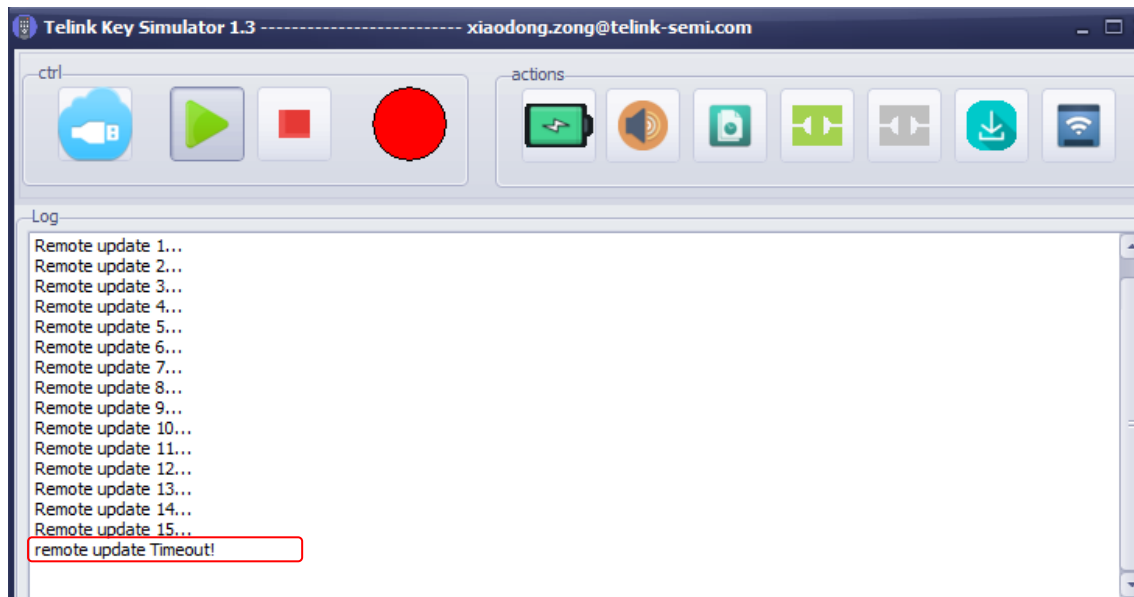


Figure 8 OTA timeout

Figure 9 indicates the OTA process fails.

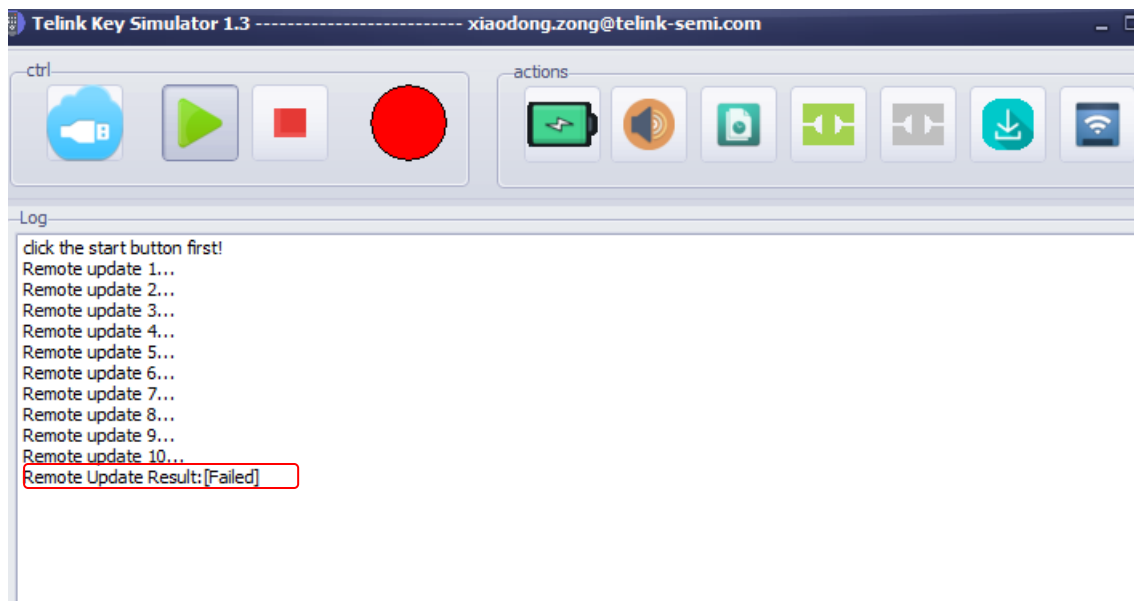


Figure 9 OTA failure

In the case of OTA failure or timeout, user should power cycle the RC and the dongle, then repeat steps 2~3 above to restart OTA process.

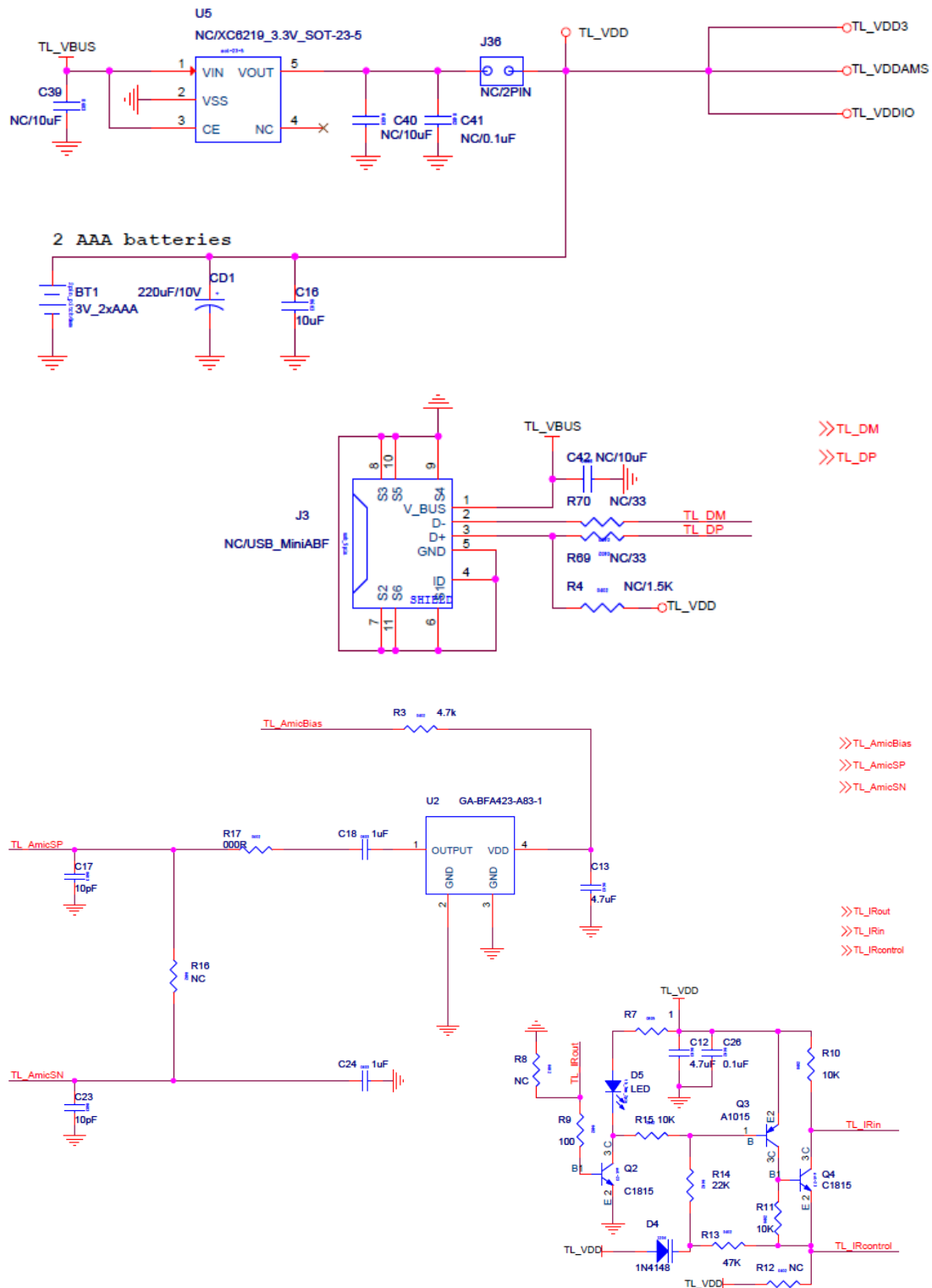
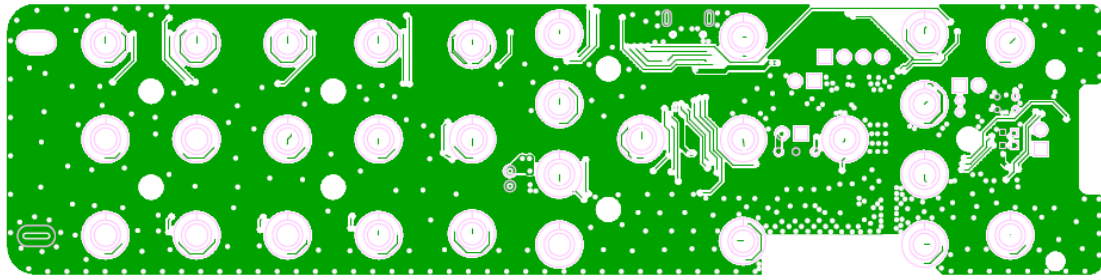
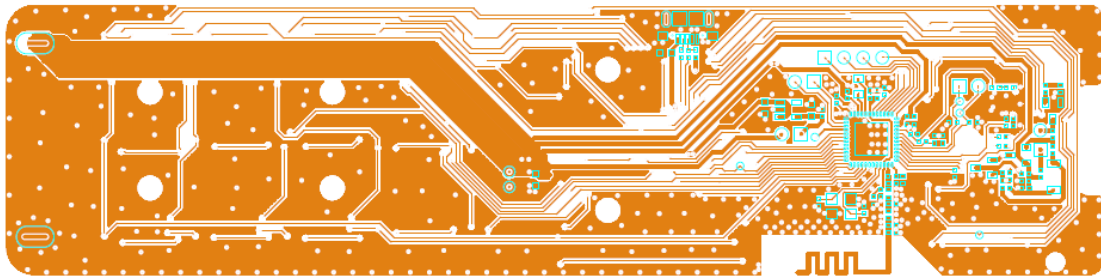


Figure 10 Schematic

13.2 PCB layout



Top view



Bottom view

Figure 11 PCB layout

13.3 Bill of Materials

Table 1 BOM table

Ref	Qty	Supplier	P/N	Description
C31	1			Cap, 0402, 18pF
L4	1	Murata	LQG15HS1N3S02D	Inductor, 0402, 1.3nH
C30	1	Murata	GRM1555C1H2R7BA01D	Cap, 0402, 2.7pF
C33	1	YAGEO	CC0402KRX7R9BB221	Cap, 0402, 220pF
C32	1	Murata	GRM1555C1H2R2BA01D	Cap, 0402, 2.2pF
L7	1	Murata	LQG15HS1N5S02D	Inductor, 0402, 1.5nH
C34	1	Murata	GRM1555C1H1R5BA01D	Cap, 0402, 1.5pF
C35	1	Murata	GRM1555C1H1R2CA01	Cap, 0402, 1.2pF
BT1	1			Connector, bat_2dip
CD1	1			Cap, cd2p0_4p0b, 220uF, 10V
C1	1			Cap, 0402, 0.1uF
C2	1			Cap, 0402, 2.2uF
C4	8			Cap, 0402, 1uF
C7				Cap, 0402, 1uF
C8				Cap, 0402, 1uF
C10				Cap, 0402, 1uF
C18				Cap, 0402, 1uF
C24				Cap, 0402, 1uF
C27				Cap, 0402, 1uF
C28				Cap, 0402, 1uF
C12	2			Cap, 0402, 4.7uF
C13				Cap, 0402, 4.7uF
C16	1			Cap, 0603c, 10uF
C17	2			Cap, 0402, 10pF
C23				Cap, 0402, 10pF
C25	1			Cap, 0402, 1uF
C26	2			Cap, 0402, 0.1uF
C29				Cap, 0402, 0.1uF
D1	2			LED, 0603-LED, Red
D2				LED, 0603-LED, Red
D4	1			Diode, SOD80, 1N4148
D5	1			IR, 2p54mm_2pin
L3	1			Inductor, 0805L, 47uH
Q2	2			NPN, SOT-23, C1815
Q4				NPN, SOT-23, C1815
Q3	1			PNP, SOT-23, A1015
R1	2			Resistor, 0402, 1K
R2				Resistor, 0402, 1K

Ref	Qty	Supplier	P/N	Description
R3	1			Resistor, 0402, 4.7k
R7	1			Resistor, 0402, 1
R9	1			Resistor, 0402, 100
R10	3			Resistor, 0402, 10K
R11				Resistor, 0402, 10K
R15				Resistor, 0402, 10K
R13	1			Resistor, 0402, 47K
R14	1			Resistor, 0402, 22K
R17	1			Resistor, 0402, 000R
U1	1		TLSR8258F512ET48	
U2	1		ga_bfa423_a83	AMIC SMD
Y1	1			Crystal, 3225, 24MHz_12pF_+/-20ppm

13.4 Silkscreen

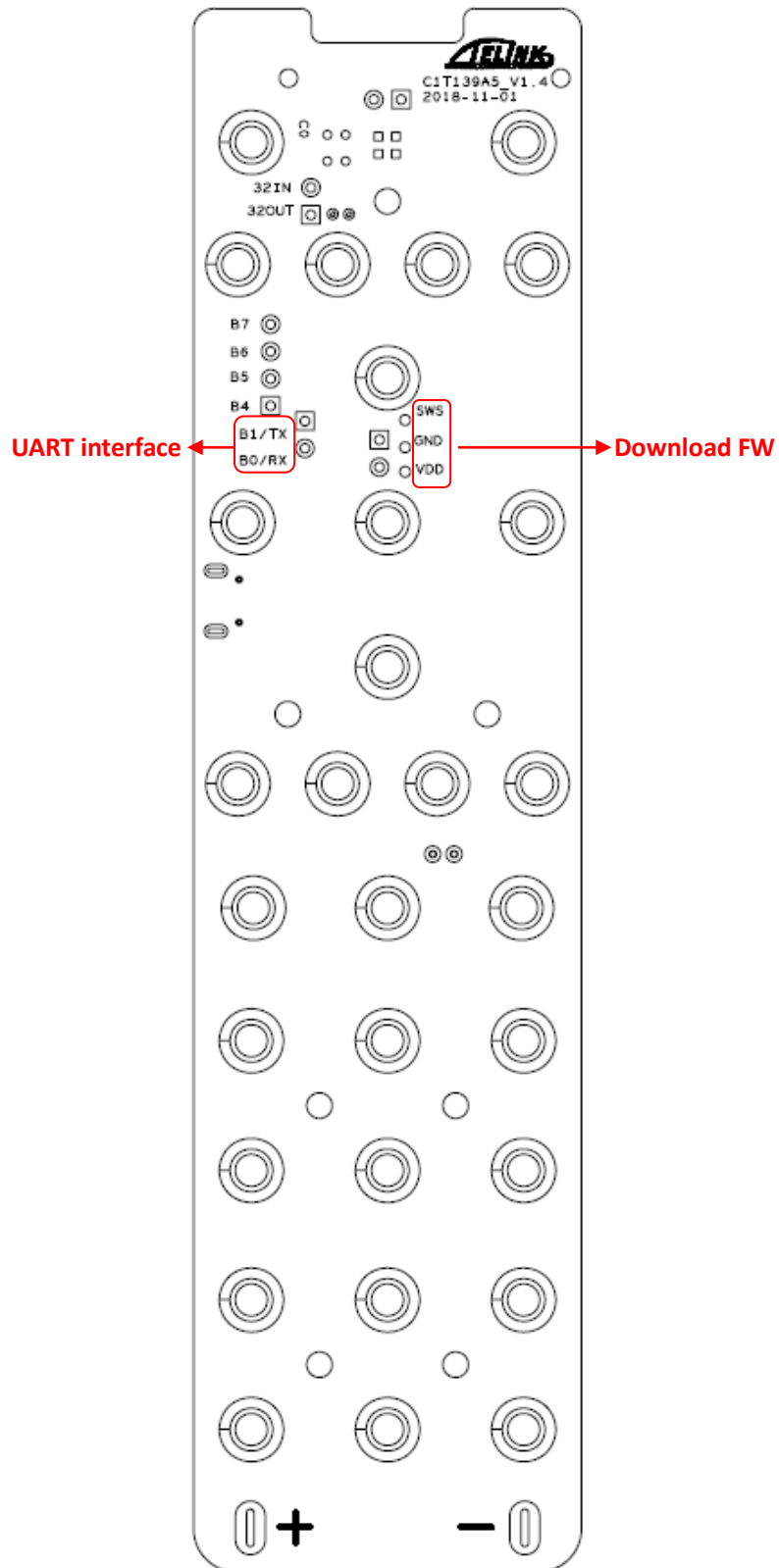


Figure 12 Silkscreen

14 Appendix 1: FCC Test Result

DUT: C1T139A5_V1_4

DUT FW: EMI binary file

Test condition: 3.3V, 25°C

Test equipment: FSQ26

Match network:

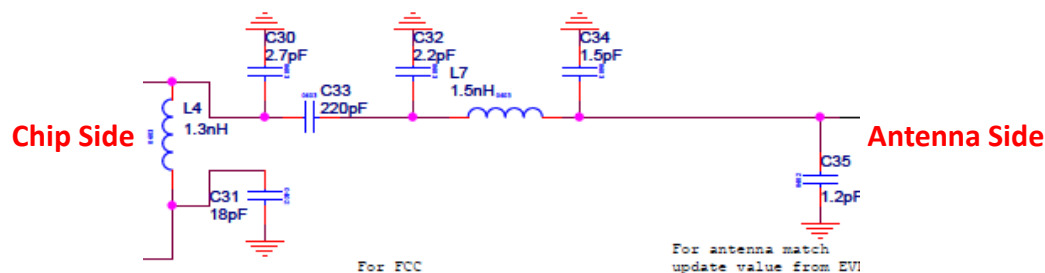


Table 2 FCC test result

No.	Test Items				Test Result
FCC (DUT FW: EMI binary file)					
1	Tx Peak Power Output - field strength				Pass
	RF Channel	2.402GHz	2.440GHz	2.480GHz	
	dBm	10.67	10.77	11.04	
2	Tx Power Spectral Density				Pass
	RF Channel	2.402GHz	2.440GHz	2.480GHz	
	dBm@100kHz	10.6	10.8	11	
	dBm@3kHz	-4.63	-4.43	-4.23	
3	Tx Minimum 6dB Bandwidth				Pass
	RF Channel	2.402GHz	2.440GHz	2.480GHz	
	MHz	689	691	683	
4	Tx Band Limit				Pass
	Frequency	30MHz ~ 2390MHz	2483.5MHz ~ 25Ghz	-	
	dB@100kHz	-42.5	-42.7	-	
5	TX Mode Harmonic (Radiated), Peak				Pass
	Frequency	4900MHz	7350MHz	9800MHz	
	dBm@1MHz	-60	-45	-47	
7	Tx Radiated emission 30-1000MHz, Peak				Pass
	Frequency	442.3MHz	953.9MHz	-	
	dBm@100kHz	-53.31	-54.58	-	

No.	Test Items				Test Result
8	Tx Radiated emission >1GHz, Average				Pass
	Frequency	1.887GHz	-	-	
	dBm@1MHz	-54.9	-	-	
9	RX Mode Spurious Emission (25MHz ~ 25GHz)				Pass
	Frequency	940.90MHz	1888 MHz	-	
	dBm@100kHz	-65	-	-	
	dBm@1MHz	-	-61.2		